National Institute of Environmental Health Sciences

# Malaria resurgence risk in southern Europe: Climate assessment in an historically endemic area of rice fields at the Mediterranean shore of Spain

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**Abstract:**

BACKGROUND: International travel and immigration have been related with an increase of imported malaria cases. This fact and climate change, prolonging the period favouring vector development, require an analysis of the malaria transmission resurgence risk in areas of southern Europe. Such a study is made for the first time in Spain. The Ebro Delta historically endemic area was selected due to its rice field landscape, the presence of only one vector, Anopheles atroparvus, with densities similar to those it presented when malaria was present, in a situation which pronouncedly differs from already assessed potential resurgence areas in other Mediterranean countries, such as France and Italy, where many different Anopheles species coexist and a different vector species dominates. METHODS: The transmission risk was assessed analysing: 1) climate diagrams including the minimum temperature for Plasmodium falciparum and Plasmodium vivax development; 2) monthly evolution of the Gradient Model Risk (GMR) index, specifying transmission risk period and number of potential Plasmodium generations; 3) ecological characteristics using remote sensing images with the Eurasia Land Cover characteristics database and the monthly evolution of the Normalized Difference Vegetation Index (NDVI); 4) evaluation of A. atroparvus population dynamics. RESULTS: Climatological analyses and GMR index show that a transmission risk presently exists, lasting from May until September for P. falciparum, and from May until October for P. vivax. The GMR index shows that the temperature increase does not actually mean a transmission risk increase if accompanied by a precipitation decrease reducing the number of parasite generations and transmission period. Nevertheless, this limitation is offset by the artificial flooding of the rice fields. Maximum NDVI values and A. atroparvus maximum abundance correspond to months with maximum growth of the rice fields. CONCLUSIONS: The Ebro Delta presents the ecological characteristics that favour transmission. The temperature increase has favoured a widening of the monthly potential transmission window with respect to when malaria was endemic. The combined application of modified climate diagrams and GMR index, together with spatial characterization conforms a useful tool for assessing potential areas at risk of malaria resurgence. NDVI is a good marker when dealing with a rice field area.

**Source:** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924348

## Resource Description

**Early Warning System:** ☒

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

**Exposure :** ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Meteorological Factors, Meteorological Factors, Temperature

**Temperature:** Fluctuations

**Geographic Feature:** ☑

resource focuses on specific type of geography

Ocean/Coastal, Other Geographical Feature

**Other Geographical Feature :** rice fields

**Geographic Location:** ☑

resource focuses on specific location

Non-United States

**Non-United States:** Europe

**European Region/Country:** European Country

**Other European Country :** Spain

**Health Impact:** ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

**Infectious Disease:** Vectorborne Disease

**Vectorborne Disease:** Mosquito-borne Disease

**Mosquito-borne Disease:** Malaria

**Mitigation/Adaptation:** ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

**Resource Type:** ☑

format or standard characteristic of resource

Research Article, Research Article

**Timescale:** ☑

time period studied

Time Scale Unspecified

**Vulnerability/Impact Assessment:** ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content